CLAIMS

1. A picture processing apparatus for receiving an input picture signal and generating an output picture signal with higher quality than the input picture signal, comprising:

first signal processing means, having storing means for storing a picture signal with the same quality as the output picture signal, said first signal processing means adding the input picture signal and the picture signal stored in said storing means so as to generate a first picture signal with higher quality than the input picture and store the first picture signal to said storing means;

second signal processing means for extracting a feature of the input picture signal corresponding to the position of a considered pixel of the output picture signal, categorizing the considered pixel as one of a plurality of classes corresponding to the feature, and calculating the input picture signal using a predetermined calculating method corresponding to the categorized class so as to generate a second picture signal with higher quality than the input picture signal; and

output selecting means for performing a determination for the first picture signal and the second picture signal and selecting one of the first picture signal and the second picture signal as the

output picture signal.

2. The picture processing apparatus as set forth in claim 1,

wherein said first signal processing means cumulates picture signals of many frames that are chronologically successive so as to generate the first picture signal.

3. The picture processing apparatus as set forth in claim 1,

wherein said second signal processing means has:

first extracting means for extracting first pixel data from the input picture signal corresponding to the position of the considered pixel of the second picture signal;

feature detecting means for detecting a feature of the first pixel data and categorizing the considered pixel as one of a plurality of classes corresponding to the feature;

second extracting means for extracting second pixel data from the input picture signal corresponding to the position of the considered pixel;

storing means for storing method information that designates a method for generating pixel data at the position of the considered pixel using the second pixel data for each class; and

pixel generating means for generating data at

the position of the considered pixel corresponding to the method information and the second pixel data.

4. The picture processing apparatus as set forth in claim 1,

wherein determination information is generated corresponding to the first picture signal and the second picture signal and said output selecting means is controlled corresponding to the determination information.

5. The picture processing apparatus as set forth in claim 1,

wherein a noise component of the output picture signal is smaller than a noise component of the input picture signal.

6. The picture processing apparatus as set forth in claim 5,

wherein said first signal processing means weights the picture signal stored in said storing means and the input picture signal depending on whether the picture of the input picture signal is still or moving, adds the weighted picture signal and the weighted input picture signal and rewrites the picture signal stored in said storing means with the added output so as to generate as the added output a first picture signal from which noise has been eliminated,

wherein said second signal processing means extracts pixels at corresponding positions of pictures

of a plurality of frames, categorizes a noise component of the pixels corresponding to the variation of the pixels among the frames as a class that is the feature and performs a predetermined calculating process corresponding to the categorized class so as to generate a second picture signal of which the noise component has been eliminated from the input picture signal, and

wherein said output selecting means determines whether the picture is still or moving in the unit of a predetermined number of pixels corresponding to the first picture signal and the second picture signal, selects one of the first picture signal and the second picture signal in the unit of the predetermined number of pixels corresponding to the determined result, and outputs the selected one of the first picture signal and the second picture signal.

7. The picture processing apparatus as set forth in claim 6,

wherein said output selecting portion has:

a determining portion for determining whether the predetermined number of pixels is a still portion or a moving portion of a picture, and

a selecting portion for selecting the first picture signal for pixels of the still portion and the second picture signal for pixels of the moving portion corresponding to the determined result of said

determining portion and outputting the selected one of the first picture signal and the second picture signal.

8. The picture processing apparatus as set forth in claim 7,

wherein said determining portion has:

a difference value calculating portion for calculating the difference value between the first picture signal and the second picture signal in the unit of the predetermined number of pixels; and

a comparing portion for outputting a determination value that represents that the pixels are the moving portion when the compared result represents that the absolute value of the difference value is equal to or larger than a predetermined threshold value and for outputting another determination value that represents that the pixels are the still portion when the compared result represents that the absolute value of the difference value is smaller than the predetermined threshold value.

9. The picture processing apparatus as set forth in claim 6,

wherein said first signal processing means has:

a motion determining portion for determining whether the picture of the input picture signal is still or moving;

a weighting portion for weighting the input

picture signal and the picture signal stored in said storing means corresponding to the determined result of said motion determining portion; and

an adding portion for adding the weighted input picture signal and the weighted picture signal that is output from said storing means, and

wherein the picture signal stored in said storing means is rewritten with the picture signal that is output from said adding portion.

10. The picture processing apparatus as set forth in claim 6,

wherein said second signal processing means has:

a motion information detecting portion for detecting motion information of a considered pixel of the picture of the input picture signal;

a class tap extracting portion for extracting a plurality of pixels at corresponding positions of the considered pixel from a plurality of frames as class taps using the motion information detected by said motion information detecting portion;

a class categorizing portion for categorizing a noise component of the considered pixel as a class corresponding to a feature of the class taps extracted by said class tap extracting portion; and

a calculation processing portion for designating a calculating process corresponding to the

class categorized by said class categorizing portion and generating a picture signal from which the noise component of the considered pixel has been eliminated by the designated calculating process.

11. The picture processing apparatus as set forth in claim 10,

wherein the feature of the class taps used by said class categorizing portion is a distribution of noise components of the plurality of pixels as the class taps.

12. The picture processing apparatus as set forth in claim 10,

wherein said calculation processing portion calculates pixel values of a plurality of pixels at corresponding positions of the considered pixel with calculation coefficients pre-designated for the plurality of pixels corresponding to the class categorized by said class categorizing portion so as to generate a picture signal from which the noise component of the considered pixel has been eliminated.

13. The picture processing apparatus as set forth in claim 10,

wherein the calculation coefficients used by said calculation processing portion are predictive coefficients that are pre-obtained, the calculation coefficients being obtained as the predictive coefficients by the steps of:

extracting a considered pixel from teacher picture data whose noise is smaller than the input picture signal;

detecting motion information of the considered pixel from student picture data whose noise is equal to the input picture signal;

extracting a plurality of pixels at corresponding positions of the considered pixel as class taps from the student picture data of a plurality of frames corresponding to the motion information detected for the considered pixel;

categorizing the noise component of the considered pixel as a class corresponding to the feature of the class taps; and

obtaining predictive coefficients for generating an output signal with the same quality as a pixel equivalent to the considered pixel extracted from the teacher signal for each categorized class.

14. The picture processing apparatus as set forth in claim 1,

wherein the output picture signal has higher resolution than the input picture signal.

15. The picture processing apparatus as set forth in claim 14,

wherein while said first signal processing means references the motion between the picture of the picture signal stored in said storing means and the

picture of the input picture signal and compensates the positions of the pixels thereof, said first signal processing means stores the input picture signal to said storing means so as to generate a first picture signal having the higher resolution in said storing means, and

wherein said second signal processing means detects the feature corresponding to a plurality of pixels including a considered pixel and pixels chronologically and spatially adjacent thereto and categorizes the feature as a class so as to generate a second picture signal having the higher resolution.

16. The picture processing apparatus as set forth in claim 15,

wherein said output selecting portion has:

a determining portion for determining the motions and the activities of the pictures of the first picture signal and the second picture signal in the unit of a predetermined number of pixels; and

a selecting portion for selecting one of the first picture signal and the second picture signal in the unit of a predetermined number of pixels corresponding to the determined result of said determining portion.

17. The picture processing apparatus as set forth in claim 16,

wherein said determining portion has:

a difference value calculating portion for calculating the difference value between the first picture signal and the second picture signal in the unit of the predetermined number of pixels; and

a comparing portion for outputting a determination value that represents that the predetermined number of pixels are the moving portion when the compared result represents that the absolute value of the difference value is equal to or larger than a predetermined threshold value and for outputting another determination value that represents that the predetermined number of pixels are the still portion when the compared result represents that the absolute value of the difference value is smaller than the predetermined threshold value.

18. The picture processing apparatus as set forth in claim 16,

wherein said determining portion has:

a still portion - moving portion determining portion for determining whether a picture is a sill portion or a moving portion in the unit of the predetermined number of pixels; and

a selection signal generating portion for supplying a signal that causes said selecting portion to select the second picture signal and output it when the determined result of said still portion - moving portion determining portion represents that a portion

of the predetermined number of pixels is a moving portion.

19. The picture processing apparatus as set forth in claim 16,

wherein said determining portion has:

a still portion - moving portion determining portion for determining whether a picture is a sill portion or a moving portion in the unit of the predetermined number of pixels;

an activity determining portion for determining which of the picture of the first picture signal and the picture of the second picture signal has a higher activity than the other; and

a selection signal generating portion for supplying a signal that causes said selecting portion to select one of the first picture signal and the second picture signal whichever has a higher activity corresponding to the determined result of said activity determining means when the determined result of said still portion - moving portion determining portion represents that a portion of the predetermined number of pixels is a still portion.

20. The picture processing apparatus as set forth in claim 19,

wherein said activity determining portion calculates a dynamic range of pixel values of a plurality of pixels in a predetermined area of each of

the first picture signal and the second picture signal and compares the two dynamic ranges that have been calculated so as to determine which of the first picture signal and the second picture signal has a higher activity.

21. The picture processing apparatus as set forth in claim 15,

wherein said first signal processing means has:

a motion detecting portion for detecting the motion between the picture of the picture signal stored in said storing means and the picture of the input picture signal; and

a picture storage processing portion for compensating the positions of pixels corresponding to the motion detected by said motion detecting portion, and adding the input picture signal to the picture signal stored in said storing means.

22. The picture processing apparatus as set forth in claim 15,

wherein said second signal processing means has:

a class tap extracting portion for extracting a plurality of pixels including a considered pixel of the picture of the input picture signal and pixels chronologically and spatially adjacent to the considered pixel as class taps;

a class categorizing portion for categorizing a feature of the class taps extracted by said class tap extracting portion as a class; and

a calculation processing portion for designating a picture conversion calculating process corresponding to the class categorized by said class categorizing portion and generating a plurality of pixels of the picture having the higher resolution corresponding to the considered pixel by the designated calculating process so as to generate the second picture signal.

23. The picture processing apparatus as set forth in claim 22,

wherein said class categorizing portion categorizes the feature of the class taps as a class corresponding to a pattern of pixel values of the plurality of pixels as the class taps.

24. The picture processing apparatus as set forth in claim 22,

wherein said calculation processing portion calculates a plurality of pixels in a predetermined area of the input picture signal corresponding to the class taps with calculation coefficients pre-designated for the plurality of pixels corresponding to the class categorized by said class categorizing portion so as to generate a plurality of pixels of the picture with the higher resolution corresponding to the considered pixel.

25. The picture processing apparatus as set forth in claim 24,

wherein the calculation coefficients used by said calculation processing portion are predictive coefficients that are pre-obtained, the calculation coefficients being obtained as the predictive coefficients by the steps of:

extracting a plurality of pixels corresponding to the considered pixel from a teacher signal with the same quality as the output picture signal;

extracting a plurality of pixels including the considered pixel and pixels chronologically and spatially adjacent thereto as class taps from a student signal with the same quality as the input picture signal;

categorizing a feature of the considered pixel as a class corresponding to the feature of the class taps; and

obtaining predictive coefficients for generating an output signal with the same quality as a pixel equivalent to the considered pixel extracted from the teacher signal using the student signal for each categorized class.

26. A picture processing method for receiving an input picture signal and generating an output picture signal with higher quality than the input picture

signal, comprising the steps of:

storing a picture signal with the same quality as the output picture signal to storing means, adding the input picture signal and the picture signal stored in the storing means so as to generate a first picture signal with higher quality than the input picture and store the first picture signal to the storing means;

extracting a feature of the input picture signal corresponding to the position of a considered pixel of the output picture signal, categorizing the considered pixel as one of a plurality of classes corresponding to the feature, and calculating the input picture signal using a predetermined calculating method corresponding to the categorized class so as to generate a second picture signal with higher quality than the input picture signal; and

performing a determination for the first picture signal and the second picture signal and selecting one of the first picture signal and the second picture signal as the output picture signal.

27. The picture processing method as set forth in claim 26,

wherein the first signal processing step is performed by cumulating picture signals of many frames that are chronologically successive so as to generate the first picture signal.

28. The picture processing method as set forth in claim 26,

wherein the second signal processing step has steps of:

extracting first pixel data from the input picture signal corresponding to the position of the considered pixel of the second picture signal;

detecting a feature of the first pixel data and categorizing the considered pixel as one of a plurality of classes corresponding to the feature;

extracting second pixel data from the input picture signal corresponding to the position of the considered pixel;

storing method information that designates a method for generating pixel data at the position of the considered pixel using the second pixel data for each class; and

generating data at the position of the considered pixel corresponding to the method information and the second pixel data.

29. The picture processing method as set forth in claim 26,

wherein determination information is generated corresponding to the first picture signal and the second picture signal and one of the first picture signal and the second picture signal is selected as an output corresponding to the determination information.

30. The picture processing method as set forth in claim 26,

wherein a noise component of the output picture signal is smaller than a noise component of the input picture signal.

31. The picture processing method as set forth in claim 30,

wherein the first signal processing step is performed by weighting the picture signal stored in the storing means and the input picture signal depending on whether the picture of the input picture signal is still or moving, adding the weighted picture signal and the weighted input picture signal, and rewriting the picture signal stored in the storing means with the added output so as to generate as the added output a first picture signal from which noise has been eliminated,

wherein the second signal processing step is performed by extracting pixels at corresponding positions of pictures of a plurality of frames, categorizing a noise component of the pixels corresponding to the variation of the pixels among the frames as a class that is the feature, and performing a predetermined calculating process corresponding to the categorized class so as to generate a second picture signal of which the noise component has been eliminated from the input picture signal, and

wherein the output selecting step is performed by determining whether the picture is still or moving in the unit of a predetermined number of pixels corresponding to the first picture signal and the second picture signal, selecting one of the first picture signal and the second picture signal in the unit of the predetermined number of pixels corresponding to the determined result, and outputting the selected one of the first picture signal and the second picture signal.

32. The picture processing method as set forth in claim 31,

wherein the output selecting step has the steps of:

determining whether the predetermined number of pixels is a still portion or a moving portion of a picture; and

selecting the first picture signal for pixels of the still portion and the second picture signal for pixels of the moving portion corresponding to the determined result at the determining step and outputting the selected one of the first picture signal and the second picture signal.

33. The picture processing method as set forth in claim 32,

wherein the determining step has the steps of:

calculating the difference value between the first picture signal and the second picture signal in the unit of the predetermined number of pixels; and

outputting a determination value that represents that the pixels are the moving portion when the compared result represents that the absolute value of the difference value is equal to or larger than a predetermined threshold value and outputting another determination value that represents that the pixels are the still portion when the compared result represents that the absolute value of the difference value is smaller than the predetermined threshold value.

34. The picture processing method as set forth in claim 31,

wherein the first signal processing step has the steps of:

determining whether the picture of the input picture signal is still or moving;

weighting the input picture signal and the picture signal stored in the storing means corresponding to the determined result at the motion determining step; and

adding the weighted input picture signal and the weighted picture signal that is output from the storing means, and

wherein the picture signal stored in the storing means is rewritten with the picture signal that

is output at the adding step.

35. The picture processing method as set forth in claim 31,

wherein the second signal processing step has the steps of:

detecting motion information of a considered pixel of the picture of the input picture signal;

extracting a plurality of pixels at corresponding positions of the considered pixel from a plurality of frames as class taps using the motion information detected at the motion information detecting step;

categorizing a noise component of the considered pixel as a class corresponding to a feature of the class taps extracted at the class tap extracting step; and

designating a calculating process corresponding to the class categorized at the class categorizing step and generating a picture signal from which the noise component of the considered pixel has been eliminated by the designated calculating process.

36. The picture processing method as set forth in claim 35,

wherein the feature of the class taps used at the class categorizing step is a distribution of noise components of the plurality of pixels as the class taps.

37. The picture processing method as set forth in

claim 35,

wherein the calculation processing step is performed by calculating pixel values of a plurality of pixels at corresponding positions of the considered pixel with calculation coefficients pre-designated for the plurality of pixels corresponding to the class categorized at the class categorizing step so as to generate a picture signal from which the noise component of the considered pixel has been eliminated.

38. The picture processing method as set forth in claim 37,

wherein the calculation coefficients are predictive coefficients that are pre-obtained by the steps of:

extracting a considered pixel from teacher picture data whose noise is smaller than the input picture signal;

detecting motion information of the considered pixel from student picture data whose noise is equal to the input picture signal;

extracting a plurality of pixels at corresponding positions of the considered pixel as class taps from the student picture data of a plurality of frames corresponding to the motion information detected for the considered pixel;

categorizing the noise component of the considered pixel as a class corresponding to the

feature of the class taps; and

obtaining predictive coefficients for generating an output signal with the same quality as a pixel equivalent to the considered pixel extracted from the teacher signal for each categorized class.

39. The picture processing method as set forth in claim 26,

wherein the output picture signal has higher resolution than the input picture signal.

40. The picture processing method as set forth in claim 39,

wherein the first signal processing step is performed, while the motion between the picture of the picture signal stored in the storing means and the picture of the input picture signal is referenced and the positions of the pixels thereof are compensated, by storing the input picture signal to the storing means so as to generate a first picture signal having the higher resolution in the storing means,

wherein the second signal processing step is performed by detecting the feature corresponding to a plurality of pixels including a considered pixel and pixels chronologically and spatially adjacent thereto and categorizing the feature as a class so as to generate a second picture signal having the higher resolution, and

wherein the output selecting step is

performed by selectively outputting one of the first picture signal and the second picture signal.

41. The picture processing method as set forth in claim 40,

wherein the output selecting step has the steps of:

determining the motions and the activities of the pictures of the first picture signal and the second picture signal in the unit of a predetermined number of pixels; and

selecting one of the first picture signal and the second picture signal in the unit of a predetermined number of pixels corresponding to the determined result at the determining step.

42. The picture processing method as set forth in claim 41,

wherein the determining step has the steps of:

calculating the difference value between the first picture signal and the second picture signal in the unit of the predetermined number of pixels; and

outputting a determination value that represents that the predetermined number of pixels are the moving portion when the compared result represents that the absolute value of the difference value is equal to or larger than a predetermined threshold value and outputting another determination value that

represents that the predetermined number of pixels are the still portion when the compared result represents that the absolute value of the difference value is smaller than the predetermined threshold value.

43. The picture processing method as set forth in claim 41,

wherein the determining step has the steps of:

determining whether a picture is a sill portion or a moving portion in the unit of the predetermined number of pixels; and

supplying a signal that causes the selecting portion to select the second picture signal and output it when the determined result at the still portion - moving portion determining step represents that a portion of the predetermined number of pixels is a moving portion.

44. The picture processing method as set forth in claim 41,

wherein the determining step has the steps of:

determining whether a picture is a sill portion or a moving portion in the unit of the predetermined number of pixels;

determining which of the picture of the first picture signal and the picture of the second picture signal has a higher activity than the other; and

supplying a signal that causes the selecting portion to select one of the first picture signal and the second picture signal whichever has a higher activity corresponding to the determined result at the activity determining step when the determined result of the still portion - moving portion determining step represents that a portion of the predetermined number of pixels is a still portion.

45. The picture processing method as set forth in claim 44,

wherein the activity determining step is performed by calculating a dynamic range of pixel values of a plurality of pixels in a predetermined area of each of the first picture signal and the second picture signal and comparing the two dynamic ranges that have been calculated so as to determine which of the first picture signal and the second picture signal has a higher activity.

46. The picture processing method as set forth in claim 40,

wherein the first signal processing step has the steps of:

detecting the motion between the picture of the picture signal stored in the storing means and the picture of the input picture signal; and

compensating the positions of pixels corresponding to the motion detected at the motion

detecting step, and adding the input picture signal to the picture signal stored in the storing means.

47. The picture processing method as set forth in claim 40,

wherein the second signal processing step has the steps of:

extracting a plurality of pixels including a considered pixel of the picture of the input picture signal and pixels chronologically and spatially adjacent to the considered pixel as class taps;

categorizing a feature of the class taps extracted at the class tap extracting step as a class; and

designating a picture conversion calculating process corresponding to the class categorized at the class categorizing step and generating the picture signal having the higher resolution by the designated calculating process.

48. The picture processing method as set forth in claim 47,

wherein the class categorizing step is performed by categorizing the feature of the class taps as a class corresponding to a pattern of pixel values of the plurality of pixels as the class taps.

49. The picture processing method as set forth in claim 47,

wherein the calculation processing step is

performed by calculating a plurality of pixels in a predetermined area of the input picture signal corresponding to the class taps with calculation coefficients pre-designated for the plurality of pixels corresponding to the class categorized at the class categorizing step so as to generate the output picture signal with the higher resolution corresponding to the considered pixel.

50. The picture processing method as set forth in claim 47,

wherein the calculation coefficients used at the calculation processing step are predictive coefficients that are pre-obtained by the steps of:

extracting a plurality of pixels corresponding to the considered pixel from a teacher signal with the same quality as the output picture signal;

extracting a plurality of pixels including the considered pixel and pixels chronologically and spatially adjacent thereto as class taps from a student signal with the same quality as the input picture signal;

categorizing a feature of the considered pixel as a class corresponding to the feature of the class taps; and

obtaining predictive coefficients for generating an output signal with the same quality as a

pixel equivalent to the considered pixel extracted from the teacher signal using the student signal for each categorized class.

51. A program for causing a computer to execute a picture process for generating an output picture signal with higher quality than an input picture signal, the picture process comprising the steps of:

storing a picture signal with the same quality as the output picture signal to storing means,

adding the input picture signal and the picture signal stored in the storing means so as to generate a first picture signal with higher quality than the input picture and store the first picture signal to the storing means;

extracting a feature of the input picture signal corresponding to the position of a considered pixel of the output picture signal, categorizing the considered pixel as one of a plurality of classes corresponding to the feature, and calculating the input picture signal using a predetermined calculating method corresponding to the categorized class so as to generate a second picture signal with higher quality than the input picture signal; and

performing a determination for the first picture signal and the second picture signal and selecting one of the first picture signal and the second picture signal as the output picture signal.

52. A computer readable record medium on which a program has been recorded, the program causing the computer to execute a picture process for generating an output picture signal with higher quality than an input picture signal, the picture process comprising the steps of:

storing a picture signal with the same quality as the output picture signal to storing means, adding the input picture signal and the picture signal stored in the storing means so as to generate a first picture signal with higher quality than the input picture and store the first picture signal to the storing means;

extracting a feature of the input picture signal corresponding to the position of a considered pixel of the output picture signal, categorizing the considered pixel as one of a plurality of classes corresponding to the feature, and calculating the input picture signal using a predetermined calculating method corresponding to the categorized class so as to generate a second picture signal with higher quality than the input picture signal; and

performing a determination for the first picture signal and the second picture signal and selecting one of the first picture signal and the second picture signal as the output picture signal.